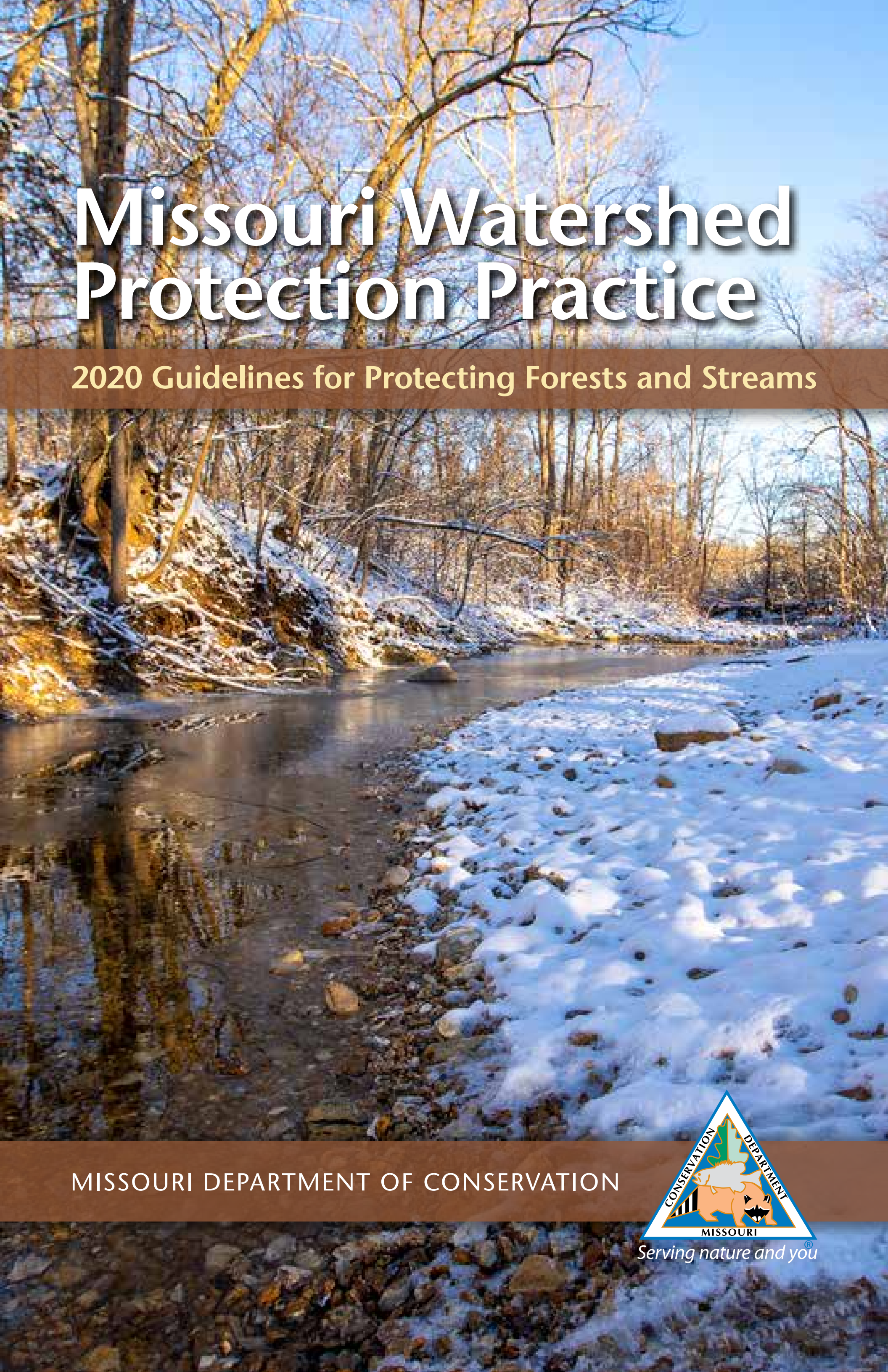
Missouri Watershed Protection Practice

2020 Guidelines for Protecting Forests and Streams



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Acknowledgments

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Illustrations by David H. Allen, Natural Resources Conservation Service, David Besenger, Missouri Department of Conservation, and Tim D. Frevert.

For more information contact
Missouri Department of Conservation
PO Box 180
Jefferson City, MO 65102-0180
573-751-4115
mdc.mo.gov

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Contents

Introduction

The purpose of this booklet is to inform landowners, loggers, foresters, and other interested persons about the nature of nonpoint source water pollution from silvicultural (forest management) operations, and to present methods for reducing nonpoint source pollution.

The methods of reducing nonpoint source water pollution are called *recommended practices*, and these are adapted to suit Missouri forests, soils, and logging conditions. The booklet review team consists of 30 persons representing various aspects of forestry in Missouri.

The review team believes these practices are economical, common-sense methods for ensuring Missouri forests continue to produce water of the highest quality.

This booklet provides a brief description of Missouri forests, including their acreage, their ownership, the contribution to the state's economy made by the forest products industry, and a description of nonpoint source water pollution control practices. Using these recommended nonpoint practices should ensure the continued flow of high quality water from Missouri forests.

The recommended practices are designed to enable public and private forest landowners and loggers to reduce nonpoint source water pollution. Voluntary adoption of the recommended practices will help ensure the sustainability of Missouri's soil, water, and forestry resources.

Information presented in this report is not to be used as the basis for setting water quality standards or as the basis for required watershed protection practices. Compliance with any watershed protection practices should be on a voluntary basis backed by a public water quality education and awareness program. Changing of water quality standards or the required use of protection practices should not be attempted without careful study of the beneficial effects gained from modifying existing silvicultural practices now in use.

Planning to protect the quality of water from nonpoint source water pollution is provided for in Sections 208 and 404 of the 1972 Federal Water Pollution Control Act (Public Law 92-500), as amended by the Clean Water Act of 1977 (Public Law 95-217), and as amended by

Section 319 of the Clean Water Act of 1987 (Public Law 100-4). The basic goal of the federal law is to protect and improve the quality of the nation's water so it is available for recreational use.

The recommendations in this publication are based, in part, on soil erosion studies carried out in the eastern hardwood forest at the Fernow Experimental Forest in West Virginia, Hubbard Brook Experimental Forest in New Hampshire, University Forest in Missouri, and Boston and Ouachita Mountains of Arkansas *(see References)*.

The logging road system, consisting of haul roads, landings, and skid roads, includes sites within timber harvest areas where sediment is produced. Sediment traced to road construction, maintenance, and use is a nonpoint source water pollutant. Compared with agricultural practices, timber harvesting and other silvicultural activities have minimal soil loss. However, 90 percent of the erosion from timber harvesting originates from the haul roads, landings, and skid roads and trails. Included in the logging road system are county- and state-maintained gravel and paved roads. In Missouri, most of the main haul roads are public roads. Construction of main haul roads usually is limited to temporary roads extending from the harvest area to public roads. These temporary-use roads are typically short and are abandoned after their initial use.

Because soil sediment — as opposed to pesticides, fertilizers, and other nonpoint sources — is the nonpoint source pollutant traced to silvicultural activities, many of the recommended practices found in this publication target reducing sediment production.

The Missouri Forest and Forest Products Industry

Timberland acreage in Missouri is estimated at approximately 14.8 million acres, or about 34 percent of the state's total land area of 44.6 million acres. About 84 percent, or 12.43 million acres, of the timberland area is privately owned by farmers and individuals. The remaining 16 percent of timberland is under management of the USDA Forest Service, US Department of Defense, state agencies, and local governments. Reserved forestland, including parks and wilderness areas where harvesting is not conducted, totals approximately 348,926 acres.

Privately owned forests are generally small acreages that are managed for a variety of objectives, including periodic income from the sale of timber, recreational uses, aesthetics, woodland pasture, and other considerations.

The forest products industry makes a significant contribution to the Missouri economy. The annual harvest of timber from Missouri forests is estimated at nearly 760 million board feet of cumulative sawtimber, veneer, stave bolts, scragg blocks, and pulpwood. In addition, over 46,000 persons are employed with wages paid totaling over $2.6 billion (MDC, 2017). The total economic impact of the forest products industry is estimated at approximately $10 billion annually.

Harvesting of timber, the most common silvicultural practice, is conducted to maintain a healthy, productive forest, to maintain a diverse selection of tree and plant species, to modify wildlife habitat, to produce commercial products, and to reach the objectives of the landowner.

To some extent, silvicultural practices can affect water quality. However, the effects are of short duration. Return to a preharvest condition occurs within three to seven years, depending upon the source of contamination. Generally, there is no permanent degradation of water resources. Timber harvesting occurs infrequently on any given specific acreage and annually affects about 2 percent of Missouri's commercial forestland.

Aboveground forest cover, consisting of the tree canopy, coarse debris, and the litter layer of decomposing leaves, has been recognized as the best protection against soil erosion. Seldom does overland flow of water occur in forestland that is free of livestock grazing.

Stream Type Identification

Identifying a stream's type and order is important for determining the level of protection it needs. Forest owners usually become familiar enough with the stream's flow patterns to identify the stream's order.

Nonephemeral (i.e. perennial and intermittent) and ephemeral streams are common in forested watersheds. Rain and snowmelt funnel through a network of stream channels called watersheds *(see Glossary)*.

For the purposes of stream protection, stream orders of 2 or greater are considered **nonephemeral streams**. This includes **perennial streams** that flow year-round with well-defined banks and natural channels, and **intermittent streams** that only flow during wet seasons but still have well-defined banks and natural channels.

Stream order 1 watercourses are considered **ephemeral streams**, or storm watercourses that only flow with runoff from rain or snowmelt and do not have well-defined banks or channels.

Figure 1. Stream Order Identification

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Streamside Management Zones (SMZs)

Streamside management zones (SMZs) are the areas adjacent to nonephemeral streams, caves, springs, and lakes that require special consideration. It is important to maintain stable stream banks in these SMZs, because sediment and a variety of water pollutants are filtered by the SMZ before entering our water resources. To ensure that water quality is maintained or improved, SMZs require special management considerations during silvicultural operations.

The filtering ability of forest SMZs helps to trap sediment. These zones also stabilize stream banks and slow floodwaters. Trees within these zones shade the streams, moderating water temperature. The deep, moist soils of many streamside forests provide excellent growing sites where there is potential for high-quality trees. Silvicultural practices should be conducted to enhance streamside forests, maintain forest productivity, and meet the landowner's objectives. Stream flow should not be altered because of a silvicultural operation.

The width of an SMZ is site-specific and is based on variables such as soil type, slope, vegetation, and stream classification. The minimum width of an SMZ is 50 feet on each side of streams classified as stream order 2. Stream orders higher than 2 must have a minimum 100-foot SMZ. *(See Table 1 for more SMZ requirements).*

Table 1.
SMZ Width for Various Waterbodies

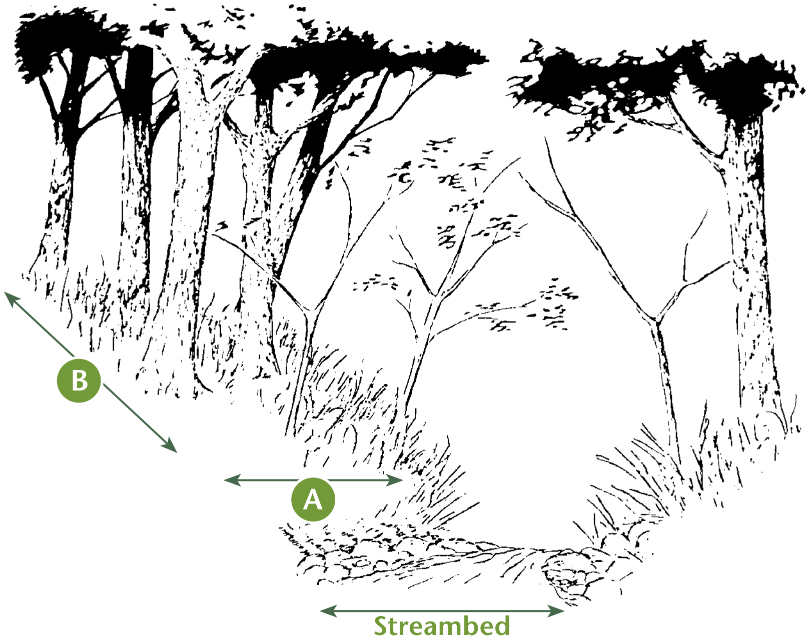
Waterbody	Minimum width of SMZ (feet)
Second order stream	50 (from each bank)
≥ Third order stream	100 (from each bank)
Ponds and wildlife watering holes	50 (from the banks of the structure)
Fens and seeps (wetlands)	100 (from the edge of moist soil)
Springs	200 (from the edge of the spring pool)

A streamside management zone is composed of two parts. The *primary zone* is 25 feet from the top of the stream bank, on each side of the stream. The *secondary zone* is variable in width and is determined by the percent slope of the adjacent land between the stream and the road or other area of soil disturbance. The secondary zone is determined by multiplying the percent slope by 2. The primary and secondary zones are then added together to determine the total width of the SMZ on any side of a stream.

Example for second order streams: The percent slope is the rise ÷ run × 100. Therefore, a rise in elevation of 5 feet over a run of 25 feet is calculated as 5 ÷ 25 = 0.20; 0.20 × 100 = 20 percent slope. The secondary zone is 2 × the percent slope. In this example, it is 2 × 20, or 40 feet. The total SMZ width, comprising both primary and secondary zones, would be calculated thus: 25 feet (primary zone) + 40 feet (secondary zone) = 65 feet on each side of the stream. This distance can be measured along the slope. It does not have to be a horizontal distance.

Figure 2 illustrates primary and secondary streamside management zones. Table 2 provides recommended SMZ widths for reducing the amount of sediment that reaches streams from disturbed areas. These widths should be considered minimum recommendations. Based on specific conditions and landowner objectives, a wider streamside zone may be preferred.

Figure 2. Primary and Secondary SMZs



A. Primary Streamside Zone — 25 feet wide, measured from the top of the stream bank on each side of the stream channel, except when associated with bluffs.

B. Secondary Streamside Zone — Width varies, depending on slope of surrounding land. Width is calculated by multiplying the slope percentage by 2. This zone begins at the top boundary of the primary zone.

Table 2.
SMZ Width for Various Land Slopes

Slope of Land Between Road and Stream (Percent)	Width of Filter Strip for Common Logging Areas (in Feet)
0	50*
10	50*
20	65
30	85
40	105
50	125
60	145

* The minimum width of an SMZ is 50 feet on each side of the stream. When determining SMZ width, apply the "50 feet minimum SMZ rule" for slopes 12 percent or less. Exception: If the stream order is 3 or greater, the minimum width of an SMZ is 100 feet on each side of the stream.

Recommended Practices for Primary SMZs

1. Harvesting operations should leave at least one-third of the typical size trees. Residual stocking of trees should be at about C-Level stocking, or 40 square feet of basal area.
2. Cable out logs, or use other methods that minimize soil disturbance.
3. Seed and/or mulch any areas with exposed soil.
4. Direct seed, hand plant, or mechanically plant new trees to assure a streamside forest.
5. Leave most trees growing on the stream bank.
6. Complete, and follow, a harvest plan prior to and during harvesting.
7. Use certified Missouri Master Loggers or loggers who have completed Professional Timber Harvester training.

Practices to Avoid for Primary SMZs

1. Using wheeled or tracked vehicles within 25 feet of the stream bank.
2. Leaving trees or tops in the water.

3. Building roads within 25 feet of the stream bank. For stream crossings, refer to the section about stream crossings.
4. Causing wildfires.
5. Performing any type of mechanical site preparation that exposes mineral soil, except for the establishment of a streamside-zone forest.
6. Using portable sawmills, log storage, or log landings.
7. Using any pesticides not labeled for use near water.
8. Livestock grazing.

Recommended Practices for Secondary SMZs

1. Harvesting operations should leave at least one-third of the typical size trees. Residual stocking of trees should be at about C-level stocking, or 40 square feet of basal area.
2. Use care with wheeled or tracked vehicles, to minimize soil disturbance.
3. Seed and/or mulch areas with exposed soil.

Practices to Avoid for Secondary SMZs

1. Building roads or trails, unless absolutely necessary for stream crossings. Refer to the section about stream crossings.
2. Using portable sawmills, log decks, or log landings.
3. Performing any type of mechanical site preparation that exposes mineral soil, except for the establishment of a streamside forest.
4. Leveling gullies, unless immediately seeded and mulched.
5. Using any pesticides not labeled for use near water.
6. Livestock grazing.
7. Causing wildfires.

Although it is not a silvicultural practice, grazing affects about 27 percent of the private forestland in Missouri. Sediment yield from unrestricted grazing on privately owned forests was identified as a more serious problem than the yield of sediment from silvicultural practices.

Stream Crossings

An increase of sediment is common at stream crossings. Road building and vehicle travel across streams should be avoided whenever possible. Careful planning prior to road construction will reduce or eliminate the number of stream crossings.

Recommended Practices for Stream Crossings

1. Plan the location of roads to minimize the number of stream crossings.
2. Install properly sized culverts where permanent logging roads cross streams *(Figure 3 and Table 3)*.
3. Locate crossings at right angles to the stream channel and where the bottom is hard and relatively level.
4. Protect permanent crossings with coarse rock or large stones.
5. Approaches to stream crossings should be made at gentle grades and should be stabilized with coarse rock extending 50 feet from both sides of the stream bank.
6. Soil around culverts, bridges, and crossings should be stabilized with coarse rock or large stones.
7. Use temporary, portable bridges.
8. Seed and mulch any exposed soil.
9. Logs and logging slash may be used, but do not cover these with soil. *Debris must be removed* from the stream immediately following completion of use.
10. Divert water off the roadway and into leaf litter so sediment is filtered out prior to the stream crossing.

Practices to Avoid

1. Creating temporary crossings of logs and brush topped with soil.
2. Doing anything that would alter the flow of stream water.
3. Crossing streams more than necessary.
4. Diverting water from landings, roads, or skid trails directly into drainages.

Access Roads and Their Construction

For most harvesting operations in Missouri, the construction of special logging roads is not required. Usually the main haul road is the county or state government-maintained gravel or paved road system. Nearly 90 percent of the erosion from timber harvests comes from the road system, where soil loss from construction and use is like soil loss from tilled crop fields. Soil loss from tilled crop fields ranges from about 2 tons per acre per year to over 100 tons per acre per year.

Where an abandoned roadbed exists, it should be evaluated for use so that new road construction is kept to a minimum. Evaluation of the abandoned road should include the recommended practices found on Page 12.

When installing a culvert in an abandoned road, make sure the top of the culvert is covered by a layer of earth whose depth is approximately half the diameter of the pipe. Tamp the soil firmly around the pipe using shovels, rakes, or similar hand implements. To ensure proper drainage, install the culvert at a 30 to 45 degree downhill angle.

Figure 3. Installing a Culvert Pipe

Table 3.
Culvert Pipe Diameter, Determined by Acres of Drainage Area

Drainage Area (in Acres)	Culvert Pipe Diameter (in Inches)
fewer than 10	15
10	18
50	42
100	48
200	72

Recommended Practices for Constructing Access Roads

***Note:** Use of all the listed practices on a given road segment may not be practical.*

1. Roads should be planned, located, and constructed to provide adequate water drainage from road surfaces. Locating roads along the contour should result in gentle grades. If the roadbed follows the contour of a steep slope, work carefully so that excessive soil disturbance does not occur.
2. Locate roads above floodplains and wet areas, if possible.
3. Road grades should be kept at less than 8 percent, except where terrain requires a short length with a steep grade.
4. Construct roads with gradual curves that are wide enough for the efficient operation of heavy equipment. The roadbed on temporary roads should be 1½ times the width of the vehicle using the road.
5. Surface roadbeds with gravel where necessary for the support of heavy equipment and to protect the road surface from erosion.
6. Keep roads reasonably free of logging debris that would prevent the free flow of water from the road surface.
7. Remove shading trees along roads as needed to expose the road to the drying effects of sunlight and air movement.
8. Pile cleared debris on the lower side of fill slopes to restrict soil movement.

9. Use culverts as needed to route water under the road. The culvert should be large enough in diameter and positioned across the road to ensure proper water drainage *(Figure 3 and Table 3)*.

10. Broad-based dips should be located at the proper intervals to channel water across the road. The dips should be sloped outward about 3 percent and surfaced with large rock for adequate drainage *(Figure 4 and Table 4)*.

11. Waterbars should be used when retiring temporary access roads and main skid trails *(Figure 5 and Table 5)*.

12. Roads constructed within streamside management zones should have all exposed soil immediately stabilized using mulch and seed where practical *(Table 6)*.

13. Water turnouts should be constructed to divert water from roadside drainage ditches so that excessive flow does not accumulate *(Figure 6 and Table 5)*.

14. Shape cut and fill slopes, seed with a cover crop, and cover with mulch to stabilize slopes *(Tables 6, 7, and 8)*.

15. When all forestry practices are completed, temporary access roads should be retired by reshaping, seeding, and mulching in combination with the use of waterbars *(Figures 5 and 7 and Tables 6 and 7)*.

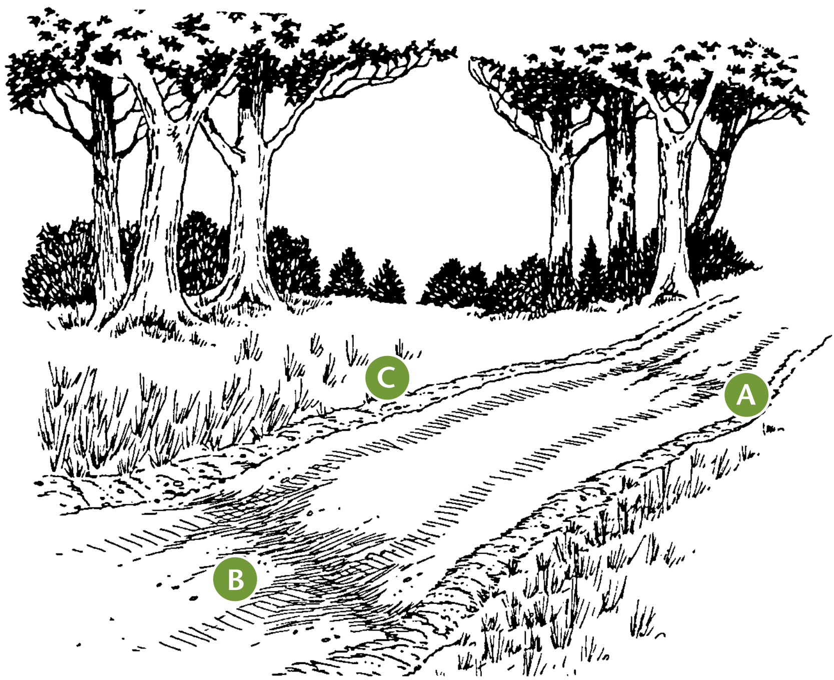
Practices to Avoid

1. Constructing roads in streamside management zones as much as possible. Refer to the protective filter strip described in Figure 2.

2. Using roads during wet or saturated soil conditions.

3. Locating roads in streambeds.

Figure 4. Broad-Based Dip Construction

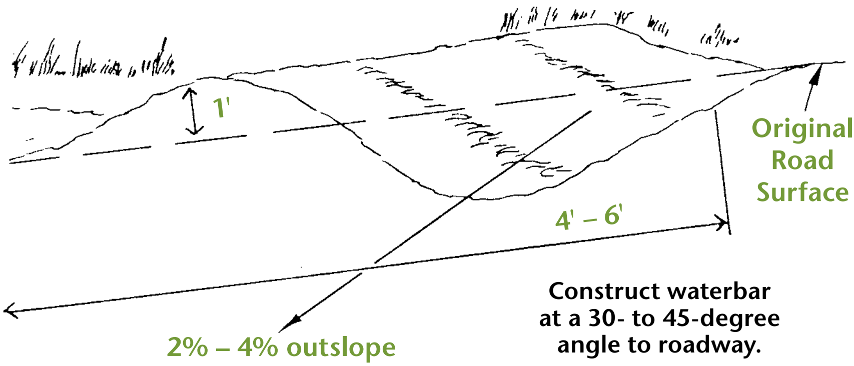


Space the dips to divert water from the road in small quantities **(A)**. Use 3-inch rock in the base of dips to allow water drainage and protect the road surface **(B)**. Seed as necessary to stabilize soil **(C)**.

Table 4.
Spacing of Broad-Based Drainage Dips

Road Grade (Percent)	Approximate Distance Needed Between Dips or Turnouts (in Feet)
1	500
2	300
5	180
10	140

Figure 5. Waterbar Construction

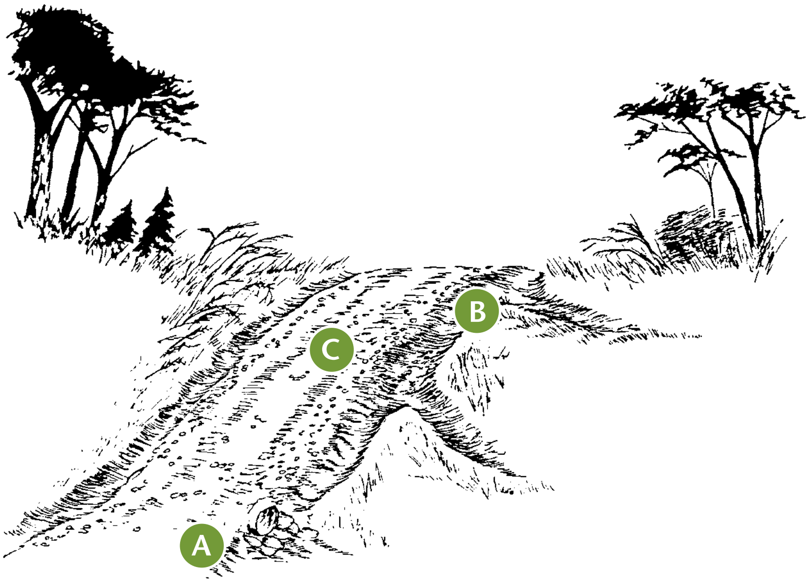


See Pages 22–24 for detailed information on how to construct a waterbar.

Table 5.
Spacing Between Waterbars

Road Grade (Percent)	Approximate Distance Needed Between Waterbars (in Feet)
1	400
2	245
5	125
10	78
15	58
20	47
25	40
30	35
35	32
40	29

Figure 6. Water Turnout Construction



Culverts collect and divert water under the road **(A).** Be sure to collect water at the top of the grade **(B)**. Water collected at midslope should be diverted from road ditches in small quantities **(C)**.

Table 6.

Permanent Cover Crop Seeding Guide

Species	Application Rate for Erosion Control (PLS/ac)	Seeding Dates Spring	Seeding Dates Fall
Cool Season Legumes			
Alfalfa	15.0	Mar 1–May 31	Aug 1–Oct 15
Ladino clover	6.0	Mar 1–May 31	Aug 1–Oct 15
Red clover	12.2	Mar 1–May 31	Aug 1–Oct 15
Warm Season Legumes			
Common lespedeza	15.0	Mar 1–Jun 30	N/A
Illinois bundle flower	29.0	Mar 1–Jun 30	N/A
Partridge pea	53.6	Mar 1–Jun 30	N/A
Round-headed bush clover	12.6	Mar 1–Jun 30	N/A
Showy tick trefoil	20.0	Mar 1–Jun 30	N/A
Cool Season Grasses			
Canada wild rye	30.6	Mar 1–May 31	Aug 1–Oct 15
Kentucky bluegrass	4.4	Mar 1–May 31	Aug 1–Oct 15
Orchard grass	8.4	Mar 1–May 31	Aug 1–Oct 15
Redtop	3.4	Mar 1–May 31	Aug 1–Oct 15
Timothy	6.2	Mar 1–May 31	Aug 1–Oct 15
Virginia wild rye	30.0	Mar 1–May 31	Aug 1–Oct 15
Warm Season Grasses			
Big bluestem	16.0	Mar 1–Jun 30	N/A
Composite dropseed	4.6	Mar 1–Jun 30	N/A
Eastern gama grass	16.0	Mar 1–Jun 30	N/A
Indian grass	15.6	Mar 1–Jun 30	N/A
Little bluestem	12.8	Mar 1–Jun 30	N/A
Sideoats grama	15.0	Mar 1–Jun 30	N/A
Switchgrass	9.4	Mar 1–Jun 30	N/A
Warm Season Forbs			
Gray-headed coneflower	7.2	Mar 1–Jun 30	N/A
Pale purple coneflower	32.8	Mar 1–Jun 30	N/A
Ox-eye false sunflower	22.6	Mar 1–Jun 30	N/A
Wild bergamot	2.8	Mar 1–Jun 30	N/A

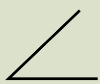
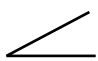
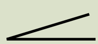
Table 7.

Temporary Cover Crop Seeding Guide

Species	Application Rate for Erosion Control (PLS/ac)	Seeding Dates Spring	Seeding Dates Fall
Buckwheat	40–60	May 1–Sept 1	N/A
Oats	60–80	Jan 20–Mar 20	Sept 1–Nov 15
Wheat	120–180	Mar 1–May 1	Sept 1–Nov 15
Winter rye	80–110	Mar 1–May 1	Sept 1–Nov 1

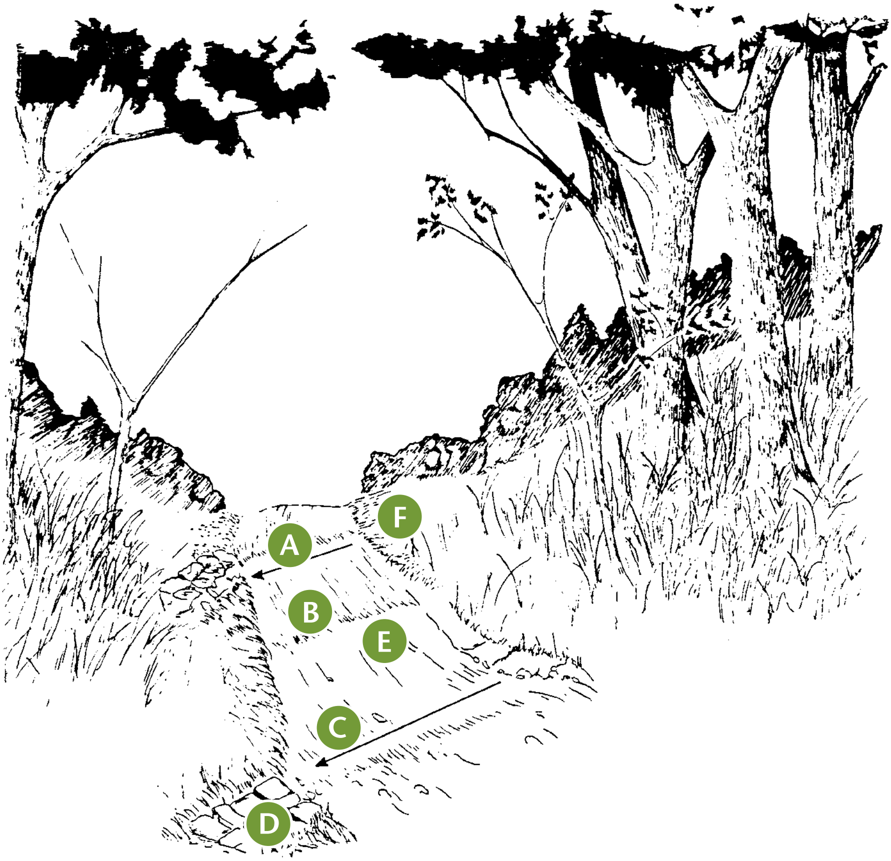
Table 8.

Guide for Stabilizing Road Banks

Slopes (rise to run)	Angle	Treatment
1 to 1		Mulching and fertilization is almost always necessary.
2 to 1		Can be loosened to apply fertilizer and seed; light mulch should be used on droughty soils.
4 to 1		Can be cultivated with machinery; drill in fertilizer and seed.

***Note:** These recommendations generally apply to road banks that are high enough to warrant treatment. It may not be practical or necessary to seed banks of many logging roads.*

Figure 7. Features of a Protected Road



Start waterbars near the top of the grade **(A)**. Additional waterbars are spaced properly at the recommended distances **(B)**. Waterbars are located at a 30- to 45-degree angle down slope **(C)**. Stone riprap can be placed at diversion outlets **(D)**. Road is sloped outward and follows the contour **(E)**. Cutbanks are seeded as necessary **(F)**.

Timber Harvesting

Missouri timber harvests typically cover small acreages, and do not require extensive road construction for access. Vegetation responds rapidly to stabilize exposed soil. Long-term studies conducted on managed forestland show that soil erosion occurs at about the same rate as naturally occurring geologic erosion. Timber harvesting activities pose little threat to water quality when care is taken to prevent or minimize soil erosion.

Recommended Practices for Timber Harvesting

1. When harvesting timber near streams, lakes, caves, and springs, follow the practices found in the Streamside Management Zones section.
2. Locate log landings on stable, adequately drained soils and positioned so that skidding is directed away from the stream course. Landings should be constructed at least 200 feet from SMZs.
3. Log landings should be no larger than necessary to handle loading activities.
4. Stabilize exposed soil by seeding when harvesting operations have been completed.
5. Portable sawmills should be located at least 200 feet from SMZs.
6. Provisions should be made at lunch areas, portable sawmills, and other places frequented by people for disposal of human waste and garbage.
7. Prior to harvesting, a harvest plan should identify SMZs, primary and secondary haul roads, landings, main skid trails, and any other special features.
8. Locate log landings and main skid trails before work begins. This will help ensure an efficient operation and will minimize the number of landings and trails needed.
9. Protect residual crop trees during harvesting. While locating skid trails, mark for removal trees that will obviously be damaged during harvesting. Use other marked or low-value trees as bumpers.
10. The total amount of area occupied by roads and skid trails should be limited to no more than 10 percent of the sale area.

11. Begin harvesting areas farthest from the landing first. Install waterbars on skid trails, and use logging slash to close skid trails when finished with use.
12. Locate roads and landings on ridgetops when possible.
13. Install temporary erosion-control structures during expected heavy rain events or during extended periods of inactivity.
14. Install erosion-control structures on all roads and skid trails at the completion of use.
15. Waterbars should be built at a 30- to 45-degree angle to roads and skid trails. Waterbars should divert water into leaf litter and should not act as a dam. Always ensure that waterbars drain into leaf litter and away from nonephemeral and ephemeral drainages.

Practices to Avoid

1. Changing the oil in logging equipment where it will have an impact on water quality. If machinery is serviced in the forest, collect the oil in containers for proper disposal. Machinery should be serviced at least 200 feet outside an SMZ.
2. Disposal of logging debris in streams and lakes.
3. Temporary crossings made from logs piled into streams. Because these are usually not removed following harvesting, the blocked stream channel alters the flow of water and increases stream bank erosion. If woody debris is used, it should never be topped with soil and should be removed from the stream immediately following completion of use.
4. Allowing skid trail ruts to exceed 8 inches in depth for a distance greater than 50 feet.
5. Allowing ruts on roads to be greater than 8 inches in depth for a distance greater than 50 feet.
6. Building waterbars that aren't angled between 30 and 45 degrees.
7. Driving vehicles or equipment over waterbars once they have been built.
8. Building waterbars that don't have an outlet.
9. Draining waterbars into ephemeral drains or streams.

How to Construct a Waterbar

One way to keep your timber harvesting activities from degrading water quality is to construct waterbars. A waterbar is an angled hump or a small dike-like surface drainage structure used to divert water from fire lines, abandoned skid trails, and roads.

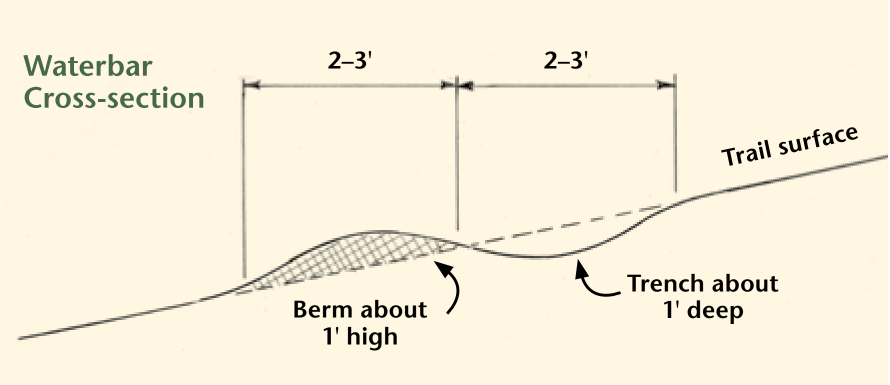
Properly constructed waterbars should be built at an angle to drain water instead of causing it to dam or pool up. A waterbar should serve as a diversion rather than a dam. Water should divert off the skid trail when it hits the waterbar.

Starting Construction of a Waterbar

The first push on a waterbar should extend beyond the upper edge of the skid trail *(see Figure 8)*. The skidder should be articulated to provide the correct 30- to 45-degree angle for the waterbar. The skidder should pull up to within 2–3 feet of the correct location for the waterbar. To start construction, put down pressure on the skidder blade, lifting the front wheels off the ground. Ease the skidder forward 2–3 feet to create the waterbar.

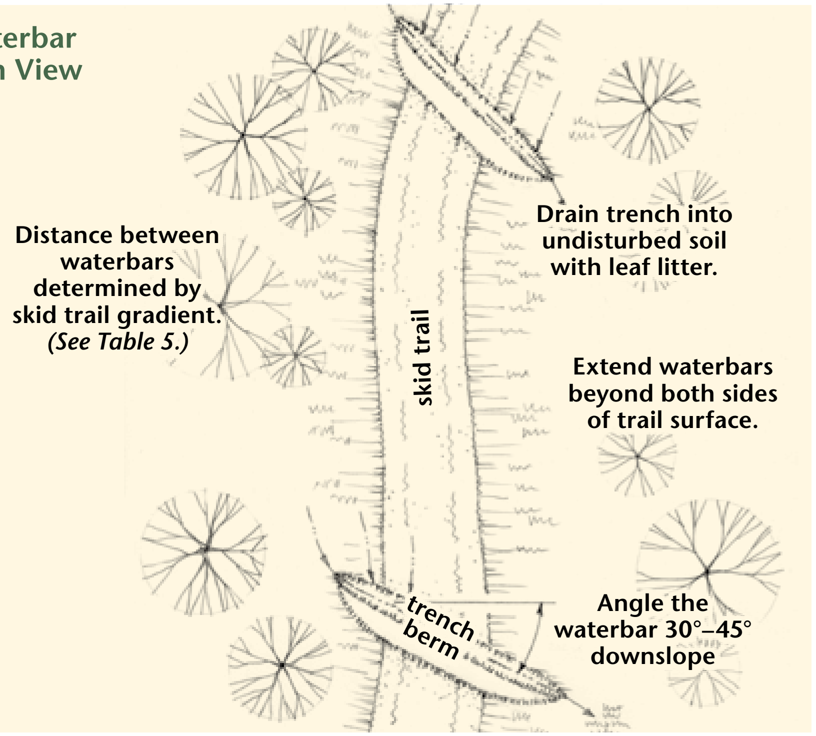

First push

Figure 8. Waterbar Schematics

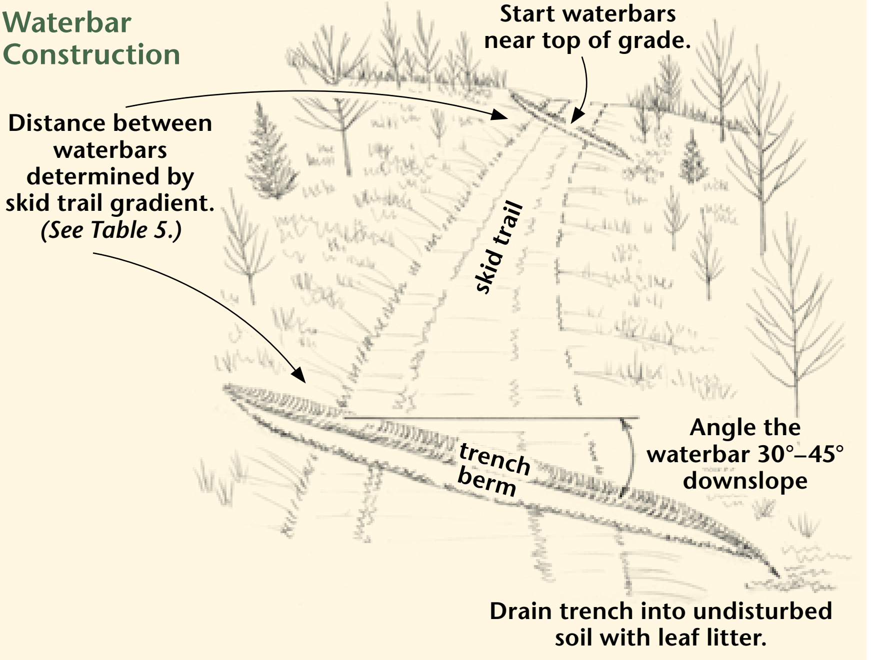


WATERBAR SCHEMATIC ILLUSTRATIONS BY TIM D. FREVERT

Waterbar Plan View



Waterbar Construction



Note that loose dirt should not be pushed into a pile to create a waterbar. A correctly built waterbar should consist of a shallow trench in the trail with dirt piled behind it.

The Second Push

The skidder will need to reposition and push a minimum of four different times to correctly complete the construction of a waterbar.


Third push

The Third Push

The skidder is currently completing the third push. Notice that the waterbar extends beyond the lower end of the skid trail, preventing water from running back into the skid trail.


Fourth push

The Fourth Push

The fourth push creates an outlet for the water. Water should be diverted into undisturbed forest leaf litter. The leaf litter can then filter out the sediment and disperse the water before it enters a stream.


Completed waterbar

Completed Waterbar

A completed, correctly built waterbar can be constructed in approximately 2 minutes. It should extend beyond both sides of the skid trail. The waterbar should be angled at 30–45 degrees from the skid trail and should drain into undisturbed leaf litter.

Waterbars are built at specific intervals, depending on the slope of the skid trail. See Table 8 for recommended spacing distances for various road grades.

Aesthetic Considerations

Scenic and recreational values are often considered to have a higher value than timber. Some people view timber harvest as unsightly. Others view harvesting as a conflict with other uses and values associated with our forests. Harvesting is necessary to maintain the health and productivity of our forests. When conducted properly, harvesting can be used to enhance many of the other uses of our forest and minimize unsightly results. The appearance of the harvest site is the “business card” for the logger who harvested the area. Consideration should be given to how landowners and the public view the site before, during, and after the harvest is completed.

Recommended Practices for Aesthetic Considerations

1. Use harvesting to open up panoramic views.
2. Slash tops down to 5 feet or less in height within approximately 100 feet of public roadways.
3. Locate landings out of the site of the public.
4. Remove all trash from the harvest site daily.
5. Remove cull logs and butt-offs from landings.
6. Seed landings after completion of use.
7. Leave scattered groups of trees in large cut areas.
8. Vary the boundaries of cutting areas to give them a more natural appearance.
9. Create visual screens and buffers along roads, especially in areas with high recreational use.
10. Salvage any damaged trees and cut spring poles.
11. Use topography to help screen harvest operations.

Practices to Avoid

1. Leaving broken trees, spring poles, or hazards.
2. Leaving trash, including hydraulic buckets, oil containers, cable, etc.
3. Leaving ruts and eroding roads, skid trails, and landings.

4. Tracking mud onto roadways.
5. Creating abrupt edges between harvest areas and unharvested forest.
6. Damaging residual trees.
7. Leaving trees hung up.
8. Decking logs in road ditches.
9. Poor use of harvested trees.

Site Preparation

Site preparation is a basic silvicultural tool used to control competing vegetation and reduce logging debris. Several procedures should be considered so that water quality is not impaired. Natural vegetation and planted tree seedlings rapidly stabilize soil. Within a three-to-four-year period following site preparation, soil loss returns to a pretreatment condition.

Recommended Practices for Site Preparation

1. Analyze and plan site preparation, considering all aspects of the practices found in the Streamside Management Zones section.
2. Bulldozing should disturb as little soil as possible.
3. When windrowing, debris should be left along the contour. Breaks should be left in the windrows to allow for fire control.
4. Seed selected herbaceous vegetation to quickly establish ground cover in addition to the tree crop.
5. Avoid mechanical site preparation that bares the soil on steep slopes.

Reforestation

Reforestation includes natural regeneration, hand and machine planting, and direct seeding. Reforestation poses little threat to water quality and is a recommended practice where filter strips are needed to trap sediment.

Since some exposure of mineral soil occurs with machine planting, there is some concern for soil erosion.

Recommended Practices for Reforestation

1. Refer to the Streamside Management Zones section for information on machine planting in streamside areas.
2. Hand plant tree seedlings on steep slopes. Mechanical tree planters are unsafe for effective operation on steep terrain.
3. Refer to USDA Natural Resources Conservation Service soil interpretations to help determine the extent of soils suited for tree planting. Soil information is available through Natural Resources Conservation Service District Conservationist offices, located in most counties.

Prescribed Burning and Fire Lines

Prescribed fire is a useful silvicultural tool when used properly. However, poor planning and weather conditions can cause too much heat in a prescribed burn, completely removing the humus layer on the forest floor and exposing the soil for erosion.

Recommended Practices for Prescribed Burning

1. Carefully plan and execute the use of prescribed fire in forestry situations while observing weather conditions.
2. Prior to burning, locate fire lines along the contour as much as possible.
3. Use the blade of the fire dozer to scrape fire lines, or use a low-impact fire plow. Construct waterbars if they are deemed necessary on deep soil, pasture, or steep slopes *(Table 5)*. In forest conditions, little or no soil loss is experienced from proper fire line construction. Leaf accumulation in the fire line helps protect the soil.
4. Keep foam products away from streams.
5. In riparian areas, avoid high-intensity fires.
6. Always locate dozed or plowed fire lines outside the primary zone (25') and when possible, outside the entire SMZ.

Chemical Treatment (Pesticides and Herbicides)

Chemicals used in silvicultural practices are applied occasionally to small acreages and at low application rates. All chemicals used in forest management activities should be labelled for that use. The Missouri Department of Agriculture regulates chemical use through certification of applicators.

Follow the directions on the chemical container regarding proper chemical use, disposal of containers, and cleaning of application equipment. Careful use of chemicals on timber stand improvements, site preparation practices, and weed-control in plantations will not result in prolonged or serious water quality degradation. Special restrictions have been placed on the use of pesticides in watersheds containing rare, threatened, and endangered species. For chemical use near water, refer to the practices found in the Streamside Management Zones section and the label of the chemical being applied.

Fertilization

Silvicultural use of fertilizers in Missouri is virtually nonexistent. Except for special cases such as tree planting on mining spoils, research projects, nursery operations, and urban settings, fertilizer is not used on large-scale forest management practices.

Glossary

Access road — A temporary or permanent road over which timber is transported from a landing site to a public road. Also known as a *haul road*.

Basal area — The cross-sectioned area of all stems of a species or all stems in a stand measured at breast height (4.5 feet from the ground) and expressed per unit of land area.

Broad-based dip — A drainage structure designed to drain water from a dirt road, allowing vehicles to maintain normal travel speeds. Also called *rolling dip*.

Buffer strip — A barrier of permanent vegetation established or left undisturbed downslope from disturbed forest areas to filter out sediment from runoff before it reaches a watercourse. Buffer strips help stabilize stream banks, protect floodplains from flood damage, and provide important fish and wildlife habitat.

Chemicals — In forestry, chemical substances or formulations that perform important management functions, such as fertilizers, herbicides, repellents, pesticides, and other treatments.

Coarse debris — Fallen trees, limbs, and rock of all sizes that have accumulated on the ground, covering the soil.

Commercial forestland — Forestland bearing, or capable of bearing, timber of commercial character, currently or prospectively available, and not withdrawn from such use.

Cut and fill — Leveling of material by excavation in one place and its deposition in an adjacent place, to produce a uniform height for roads, waterbars, etc.

Ephemeral streams — A stream or portion of a stream that flows only in direct response to precipitation, receiving little to no water from springs and no long continued supply from snow or other sources, and whose channel is at all times above the water table. Also referred to as stream order one. Protection of an SMZ is **not** required.

Erosion — The process by which soil particles are detached, entrained, and transported by water, wind, and gravity to some downslope or downstream point.

Felling — The process of cutting down standing trees.

Forestland — Land bearing forest growth, or land from which the forest has been removed but which shows evidence of past forest occupancy and which is not now in other use.

Forest practice — The activity of growing, protecting, harvesting, or processing of forest tree species on forestland. This includes the manipulation of forest resources for other benefits, such as wildlife and recreation.

Forest road — An access route for vehicles into forestland.

Harvesting — The felling, skidding, loading, and transporting of timber products (pulpwood, poles, sawlogs, etc.).

Herbicide — Any substance or mixture of substances intended to prevent the growth of or destroy unwanted woody or nonwoody terrestrial or aquatic plants.

Intermittent stream — A stream or portion of a stream that does not flow year-round, but only when it receives base flow solely during wet periods, or receives groundwater discharge or protracted contributions from melting snow or other erratic surface and shallow subsurface sources. Also called a nonephemeral stream. Protection of an SMZ is required.

Litter layer — The layer of fallen leaves, twigs, and decaying woody material that provides a spongelike mat covering forest soils.

Live stream — See *Perennial stream*.

Logging debris — The unused and generally unmarketable accumulation of woody material, such as large limbs, tops, cull logs, and stumps, that remains after timber harvesting.

Log landing — A place where logs or tree-length materials are assembled for loading and transport. Also called *log deck, log yard, brow,* or *bunching area*.

Mulch — Any loose covering of organic residues, such as grass, straw, or wood fibers, placed upon soil to check erosion and stabilize exposed soil.

Nonephemeral stream — A perennial or intermittent stream that has a defined channel and often has banks; a stream classified as a second-order stream or larger, often with permanent pools of water in the channel or having a continuous flow of water throughout the year. Water flows more often than only immediately after a rain. Protection of an SMZ is required.

Nonpoint source pollution — Pollution that cannot be traced to any one source; water pollution caused by diffuse sources that are not regulated as point sources. Normally associated with agricultural, silvicultural, urban, and construction site runoff.

Perennial stream — A nonephemeral watercourse that flows throughout the year in a well-defined channel. Also called *live stream*.

Pesticides — Chemicals that are used to kill undesirable insects, disease, vegetation, animals, or other forms of life.

Point source pollution — Pollution that comes from a stationary location or fixed facility from which pollutants are discharged or emitted or any single, identifiable discharge point of pollution, such as a pipe, ditch, concentrated livestock operation, floating craft, or smokestack.

Prescribed burning — The use of controlled fires to reduce or eliminate undesirable vegetation or unincorporated organic matter of the forest floor.

Recommended practices — A collection of practices determined to be the most effective, practical means of achieving, for example, water quality objectives.

Regeneration — The process of renewing a forest with a young tree crop replacing older trees removed by harvest or disaster; the process of replacing old trees with young ones.

Silviculture — Practices that are directed toward the creation and maintenance of a forest that will best fulfill the objectives of the owner. Note that the cutting of a forest as part of a land use change, as in the conversion of forest to pasture, cropland, a parking lot, or other nonforest use, is not a silvicultural practice.

Site preparation — In forests, the removal of unwanted vegetation and other material, and soil cultivation and other preparation, prior to reforestation. Such activities include bulldozing, brush hogging, and use of herbicides.

Skid trail (Skid road) — A temporary, frequently used pathway for dragging felled trees or logs to a log landing.

Slope percent — The grade of a hill expressed as a percentage. ***Example:*** A vertical rise of 10 feet and a horizontal distance of 100 feet equals a 10-percent slope.

Streamside zone — An area adjacent to the banks of streams and bodies of open water where extra precaution is necessary in carrying out forest practices to protect the stream bank and water quality.

Thermal pollution — Within a body of water, a temperature rise sufficient to harm aquatic life.

Timberland — Forestland not restricted from harvesting by statute, administrative regulation, or designation that is capable of growing trees at a rate of 20 cubic feet per acre per year at minimum annual increment.

Timber stand improvement — Cutting trees between planting and harvest, including the pruning of tree branches, to control the stocking, quality, and tree species composition of a timber stand.

Tree canopy — The upper part of the forest, consisting of individual tree crowns or the interlocking tree branches.

Waterbar — An angled hump or small dikelike surface drainage structure used to divert water from fire lines, abandoned skid trails, and roads. Waterbars are used to minimize soil erosion.

Watercourse — A channel where water flows either ephemerally or nonephemerally. Can be also used to include bodies of open water.

Watershed — An area within the boundary of a surface drainage divide, such that all the water in the areas eventually drains to the same watercourse.

Water turnout — An extension of an access road's drainage ditch into a vegetated area or stone riprap to provide for the dispersion and filtration of storm water runoff.

Windrow — Logging debris and unmerchantable woody vegetation that has been piled into rows to be burned or allowed to decompose; also, the act of constructing windrows.

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